

NAVAL RESEARCH LABORATORY

E.O. Hulburt Center for Space Research

Monthly Progress Report
for the
SOLAR-B Mission
Extreme Ultraviolet (EUV) Imaging Spectrometer (EIS)
Instrument Components

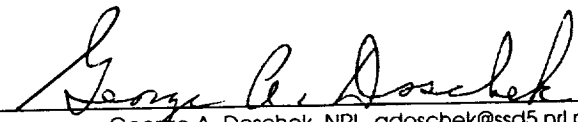
Phase C/D Cumulative Project Period Through 30 June 2001

EIS_Prog_Report23

15 July 2001

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**George C. Marshall Space Flight Center
National Aeronautics and Space Administration
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1.0 INTRODUCTION

This Monthly Progress Report covers the reporting period through June 2001, Phase C/D, Detailed Design and Development Through Launch Plus Thirty Days, for selected components and subsystems of the Extreme ultraviolet Imaging Spectrometer (EIS) instrument, hereafter referred to as EIS Instrument Components. This document contains the program status through the reporting period and forecasts the status for the upcoming reporting period. This document has been developed in accordance with Data Requirements Description 887MA-002.

2.0 PHASE B SCHEDULE

Appendix A presents the EIS Instrument Components program schedule, reflecting progress through June 20, 2001 and which will serve as the baseline program schedule for the EIS Critical Design Review (CDR). The program schedule reflects activities through Phases C/D and launch. The program schedule reflects the one-year launch delay.

3.0 SUMMARY OF WORK ACCOMPLISHED DURING REPORTING PERIOD

During the month of June, the following work was accomplished on the EIS Instrument Components.

3.1 Science Objectives

The working group on science data products (Mariska, Zarro, and Hansteen) developed a first pass at a brief statement of the science data products that EIS expects to produce on a routine basis. The statement was iterated among the working group members, distributed among a few other key EIS scientists for comment, sent to MSSL for more general distribution, and forwarded to John Davis at MSFC.

EIS Science Data Products

Low-Level Science Data Products

The basic science data products from EIS (Level 1) will be FITS files of the observations and an EIS observing catalog. Each FITS file will contain decompressed data from a single raster. A raster consists of a number of similar exposures. Each exposure consists of a set of spectral lines covering a varying number of spectral pixels but with a common number of pixels extracted along the slit. The catalog will be in the form of a relational database containing the details of each observation EIS makes. Search software will allow users to query the database to obtain information on observations made that satisfy any of a number of search criteria, such a solar location, emission lines observed, etc.

Processed Science Data Products

In addition to the Level 1 science data products, the EIS team will produce higher level science data products to aid in the scientific exploitation of the EIS observations. These will include:

Intensity maps - images of the region being rastered constructed using the zeroth moment of the strongest spectral lines.

Doppler shift maps - images of the region being rastered constructed using the first moment of the strongest spectral lines.

Line width maps - images of the region being rastered constructed using the second moment of the strongest spectral lines.

The EIS team envisions routinely producing quicklook versions of these products. These will be generated as soon as data sets arrive from KSC and will allow rapid assessment of the data. When all the data for a particular time period are available for processing, more complete maps will be produced as part of the generation process for the Level 1 FITS files. These products will be written to files in a TBD format.

Along with the data files containing the maps discussed above, the EIS team will produce corresponding GIF/JPEG/PNG images and make them available online. Software for generating the images and a Web-based application for searching and retrieving desired images will be developed. EIS expects the other Solar-B experiments to develop similar Web-based products. A coordinated effort to integrate these into a single Web site would greatly enhance the usability of the data.

For detailed scientific analysis, these higher level products require considerable processing of the data and for any given observation the data product in physical units will be subject to the natural evolution of the EIS team's understanding of the necessary corrections for instrumental effects and issues such as radiometric calibration and spacecraft pointing fluctuations. Thus, the EIS team's approach to producing these data products for detailed scientific analysis is to provide IDL routines to allow each user to produce the products from the Level 1 FITS files as required.

3.2 Design Principles

3.2.1 Hardware Design

Various aspects of the EIS hardware design were worked during the reporting period. A summary of these activities includes:

- The SEF filter frame is being manufactured at Luxel and SEF covers are being manufactured at NRL.
- The Clamshell flexures delivered with the EM Clamshell from the University of Birmingham were shown, through analysis, to be inadequate to support the launch loads. Through combined efforts with the University of Birmingham, the flexures were redesigned and will be fabricated by NRL. During the reporting period,

NRL purchased the 7075 aluminum for manufacturing of clamshell flexures for vibration testing;

- Successfully installed the DM FFA filter quadrants into the EM Clamshell;
- Prepared the EM Clamshell for vibration and acoustic testing;
- Pre-vibration baseline testing of DM MIR on the motor, resolver, PZT and optical alignment;
- The DM MIR assembly successfully completed vibration testing to qualification levels at the NRL test facility;
- Successfully completed post-vibration testing of the DM MIR on the motor, resolver, PZT and optical alignment;
- Performed DM MIR thermal bench tests;
- NRL received official notification for the build, test and delivery of the flight model Mechanism Driver Electronics (MDE) printed circuit assemblies;
- NRL placed ATC under contract to provide flight MDE parts procurement, screening, PCB fabrication and PWA assembly;
- ATC developed the draft MDE EEE Parts Procurement Plan;
- The draft MDE EEE parts list was developed;
- A preliminary Mean Time Between Failure analysis was conducted on the MDE design;
- The engineering team was very active in developing the engineering documentation required for the CDR Data Package as well as preparing for presenting at the CDR during the next reporting period.

3.2.2 Systems Engineering

Continued participation in weekly teleconference calls with MSSL and the University of Birmingham, via a three-way calling scheme, to discuss EIS systems engineering issues. Emphasis has been placed on statusing the MTM/TTM build and test program currently underway in the UK.

3.3 Documentation

3.3.1 Contract Documents

During the reporting period the following documents were submitted:

- EIS Instruments Components Monthly Progress Report submitted in accordance with 887MA-002;
- EIS Instrument Components Financial Management Report (533M) submitted in accordance with DRD 887MA-003;
 - The updated EIS Instrument Components Configuration Management Plan submitted in accordance with 887CM-001;
 - The updated EIS Instrument Components Contract End Item Specification submitted in accordance with 887CM-002;

- The updated EIS Instrument Components Interface Control Document submitted in accordance with 887CM-003;
- EIS Instrument Components Handling and Transportation Plan submitted in accordance with 887LS-001;
- The updated EIS Instrument Components Project Management Plan submitted in accordance with 887MA-001;
- EIS Instrument Components Critical Design Review Data Package submitted in accordance with 887MA-006;
- EIS Instrument Components Data Management Plan submitted in accordance with 887MA-007;
- The updated EIS Instrument Components Contamination Control and Implementation Plan submitted in accordance with 887MP-001;
- The updated EIS Instrument Components Product Assurance Plan submitted in accordance with 887CM-001;
- The updated EIS Instrument Components System Error Budget submitted in accordance with 887SE-001;
- The updated EIS Instrument Components Verification Plan submitted in accordance with 887VR-001.

3.4 Meetings

There were no official program meetings conducted during the reporting period.

4.0 SUMMARY OF WORK TO BE ACCOMPLISHED DURING UPCOMING REPORTING PERIOD

During the next month, July 2001, the following work is scheduled to be conducted on the EIS Instrument Components.

4.1 Science Objectives

Continue working in the Science Working Groups. Support the EIS science during the EIS CDR.

4.2 Design Principles

Work will continue on further defining the Development Model EIS optical and mechanism designs. The DM MIR will enter thermal vacuum testing; the EM Clamshell and DM FFA's will be subjected to qualification level vibration and acoustic testing. Weekly systems engineering conference calls will continue with the UK EIS teams. The engineering team will support the EIS CDR.

4.3 Documentation

During the next reporting period, the following documentation is to be submitted:

- EIS Instrument Components Monthly Progress Report per 887MA-002;
- EIS Instrument Components Financial Management Report (533M) per 887MA-003;

4.4 Meetings

The EIS Critical Design Review is scheduled to be conducted at the Solar-B Project Office facility in Huntsville, AL on July 11 and 12, 2001.

5.0 TECHNICAL PROBLEMS AND IMPACT TO SCIENCE OBJECTIVES

At this time there are no significant problems identified that would impact the EIS science objectives.

6.0 SCIENCE INSTRUMENT INTERFACES

Table 1 presents the updated mass estimates for the complete EIS instrument.

7.0 CURRENT AREAS OF CONCERN

The following areas are of concern at this time to the EIS development program:

- The necessity to implement adequate contamination control in Japan upon delivery of the EIS flight hardware to prevent contaminating the EIS optics.
- The NRL engineering team has completed a preliminary contamination model for the FFA and front aperture of the EIS instrument. These results show that there are serious concerns with contamination impacts from the spacecraft. NRL is working with MSSL to inform the J-side of the concerns and recommendations.

8.0 COST SUMMARY

Cost data has been removed from the Monthly Report and included as part of the EIS Instrument Components Financial Management Report (533M).

9.0 RISK ASSESSMENT

Table 2 contains a listing of the top ten risks associated with the NRL EIS Instrument Components program. The purpose of this list is to identify and track the top ten risks. Each risk is assigned a probability figure, which can be described qualitatively as:

<i>Term</i>	<i>Notation</i>
Impossible	0
Very unlikely	1
Unlikely	2
Moderately Unlikely	4
Moderately Probable	6
Probable	8
Very Probable	9
Certain	10
Unknown	99

Table 1. EIS Instrument Estimated Mass Figures

ITEM	ACRONYM	MASS (kg)	TOTAL (kg)	COMMENTS
NRL Instrument Components				
Primary Mirror	MIR	3.37		Per NRL ICD
Grating	GRA	1.52		Per NRL ICD
Filters	FFA & SEF	0.19		Per NRL ICD
Slit/Slot/Shutter Assembly	SLA	0.73		Per NRL ICD
	TOTAL		5.81	
EIS Instrument				
NRL Instrument Components		5.81		
Structure	STR	28.00		Composite structure
Launch Lock	LOK	1.00		Typical for LASCO type
Mirror Mount		0		Included in Primary Mirror
Scan Mechanism		0		Included in Primary Mirror
Grating Mount		0		Included in Grating
Grating Mechanism		0		Included in Grating
Focal Plane Assembly	FPA	0.9		Estimate
Shielding		0.60		Estimate
Readout Electronics	ROE	2.50		Estimate
Radiator		4.00		Estimate
Comtam Monitors	QCM	0.36		
Sensors & Heaters		0.20		Estimate
Multilayer Insulation	MLI	3.00		15 layer blankets with alternating mesh
Instrument Control Unit	ICU	6.55		Estimate
Harness	HAR	4.00		Scaled from LASCO
Clamshell	CLM	2.50		
Mech/Heater Control	MHC	3.0		Estimate
Purge Harness	PUR	2.0		Estimate
Vacuum Harness	VAC	1.0		Estimate
Unaccounted mass held by UK side		2.01		
	Total		67.43	

Table 2. Top Ten Risks Associated with the NRL EIS Instrument Components

Priority	Probability	Event	Effect	Management	Notes
1	2	Failure of the flight Grating optic manufacturer (Zeiss) to meet the procurement specifications; manufacturing defects.	Depending on degree of defects, optics may be found to produce loss of throughput, may be unusable for flight.	NRL has placed three Grating optics on order in accordance with the Grating Procurement Specification. In addition, NRL has placed on order, with Zeiss, three optical blanks as back-up optics to minimize the procurement time.	Zeiss has proven capabilities to meet the procurement specifications for making the Grating optics.
2	4	Failure of the flight Mirror optic manufacturer (Tinsley) to meet the delivery schedule.	Late delivery will impact delivery of the flight MIR assembly to the UK for EIS Instrument integration.	NRL has implemented schedule contingency into the flight MIR development program. NRL is currently looking into a back-up MIR optics vendor.	
3	2	MIR optics inadequately figured or polished.	Poor focusing properties leading to loss of spatial and spectral resolution. Possible need for rework.	NRL has calculated an optics error budget. In addition, three flight MIR optics are being produced.	
4	2	Multilayer coating fails to provide adequate reflectivity or other properties.	Loss of optical throughput	<ol style="list-style-type: none"> 1. There is currently a test program underway where a series of wafer samples are undergoing the multi layer coating process and then evaluated for performance; 2. Three optics for both the MIR and GRA are being procured to allow for errors.. 	
5	2	Subassembly failure during environmental testing	Delay in delivery while rework and retest are underway.	The program schedule currently contains six weeks of schedule contingency for the test program.	
6	4	Excessive lead times on flight components for the flight Mechanism Driver Electronics printed circuit boards.	Delay in delivery of the MDE PWA's to MSSSL for integration into the Mechanism and Heater Controller.	<ol style="list-style-type: none"> 1. Evaluate all potential, qualified component vendors; 2. Identify compatible replacement part numbers; 3. Allow adequate schedule contingency 	NRL received official confirmation for delivery of the flight MDE PWA's in June 2001. Currently there are no components with excessive leadtimes, however, final parts procurement is not complete.
7	2	Failure of a lot of MDE flight components during additional component screening	Delay in delivery of the MDE PWA's to MSSSL for integration into the Mechanism and Heater Controller.	<ol style="list-style-type: none"> 1. Identify high risk components; 2. Identify compatible replacement part numbers 3. Allow sufficient lead time in the schedule for a re-buy if necessary. 	

Table 2. Top Ten Risks Associated with the NRL EIS Instrument Components (Continued)

Priority	Probability	Event	Effect	Management	Notes
8	1	Failure of an NRL delivered component to integrate properly into the EIS Instrument	Delay in delivery of the EIS Instrument to the J-side during rework and retest.	<ol style="list-style-type: none"> 1. NRL has provided mass models of the GRA, SLA and MIR confirming the subassembly footprints for inclusion into the EIS MTM/TTM model; 2. NRL has integrated the FFA into the University of Birmingham provided EM Clamshell assembly; 3. NRL has successfully integrated the breadboard MDE Analog and Digital PWA's to the MSSL provided MHC EM power subsystem. 	
9	4	Contamination of EIS Instrument Components optics during handling, test or storage while still at NRL.	Loss of optical throughput; possible catastrophic failure of optical component.	<ol style="list-style-type: none"> 1. Implement witness sample monitoring to track flight optics; 2. Spare flight optics have been procured; 3. Implement adequate contamination monitoring and controls 	
10	8	Contamination of the EIS Instrument during integration, test and early orbit.	Loss of total instrument throughput.	NRL is working with the UK contamination team to ensure that adequate controls and design modification are incorporated.	Under the current EIS Instrument design, the preliminary contamination model performed on the FFA and front aperture of the instrument shows a high probability of contamination from the spacecraft.

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Appendix A. EIS Instrument Components Baselined Master Schedule

WBS Code		Description		Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
0.1		Solar-B Master Schedule Major Milestones		1053 *	08/20/01	09/01/05						
1.1		Protomodel Test in Japan		20	08/20/01 *	09/14/01						
1.2		MTM/TTM Test in Japan		160	12/03/01 *	07/12/02						
1.3		EIS Instrument Flight Hardware Due at ISAS		0	12/02/03							
1.4		S/C Integration and Test		427	12/02/03	07/20/05						
1.5		Launch		0	09/01/05							
0.2		Solar-B EIS Instrument Components		1139 *	02/01/99 A	10/31/05						
A		Phase A: Concept Study		0	02/01/99 A	10/29/99 A						
B		Phase B: Definition and Preliminary Design		0	11/01/99 A	12/31/00 A						
C		Phase C: Detailed Design		15	01/01/01 A	07/10/01						
D		Phase D: Development Through Launch Plus 30 Days		1103	07/11/01	09/30/05						
E		Phase E: Mission Operations and Data Analysis		21	10/03/05	10/31/05						
1.0		Management, Science & Co-Investigators		1139 *	02/01/99 A	10/31/05						
1.1		Project Management		1059 *	09/01/99 A	08/01/05						
1.1.1		Meetings - Programmatic		1059 *	09/01/99 A	08/01/05						
1.1.1.1		Requirements Review		0	09/01/99 A	09/02/99 A						
1.1.1.2		Concept Review		0	10/28/99 A	10/29/99 A						
1.1.1.3		Preliminary Design Review		0	05/11/00 A	05/11/00 A						
1.1.1.4		EIS Instrument UK Preliminary Design Review		0	07/06/00 A	07/07/00 A						
1.1.1.5		Confirmation Review		0	11/30/00 A							
1.1.1.6		Critical Design Review		0	07/10/01							
1.1.1.7		Pre-Environmental Review		0	01/24/02							
1.1.1.8		Pre-Ship/Acceptance Review		0	08/01/02							
1.1.1.9		Mission Readiness Review		0	08/01/05							
1.1.2		Meetings - Scientific		3 *	11/15/99 A	08/31/01						
1.1.2.1		EIS Science Meeting - NRL		0	11/15/99 A	11/19/99 A						
1.1.2.2		SOLAR-B Science Meeting - ISAS		0	12/09/99 A	12/10/99 A						
1.1.2.3		EIS Science Meeting - MSSL		0	02/09/00 A	02/09/00 A						
1.1.2.4		EIS Science Meeting - MSSL		0	05/24/00 A	05/26/00 A						
1.1.2.5		EIS Science Meeting - RAL		0	11/15/00 A	11/17/00 A						
1.1.2.6		Solar-B Science meeting - ISAS		0	12/04/00 A	12/06/00 A						
1.1.2.7		EIS Science Meeting - MSSL		0	04/23/01 A	04/24/01 A						
1.1.2.8		EIS Science Meeting - NRL		3	08/29/01	08/31/01						
1.1.3		Meetings - Technical		0 *	12/11/99 A	02/23/01 A						
1.1.3.1		EIS Engineering Meeting - ISAS		0	12/11/99 A	12/15/99 A						
1.1.3.2		EIS Engineering Meeting - ISAS		0	03/06/00 A	03/08/00 A						
1.1.3.3		EIS Engineering Meeting - ISAS		0	06/20/00 A	06/22/00 A						
1.1.3.4		EIS Engineering Meeting - Univ. Birmingham		0	10/04/00 A	10/06/00 A						
1.1.3.5		EIS Engineering Meeting - ISAS		0	12/07/00 A	12/09/00 A						
1.1.3.6		Engineering Working Group- Univ. Birmingham		0	02/21/01 A	02/23/01 A						
1.2		Project Planning and Control		1139 *	03/01/99 A	10/31/05						
1.2.1		Documentation		1139 *	03/01/99 A	10/31/05						
1.2.1.1		Requirements Review Data Package		0	09/28/99 A	09/28/99 A						
1.2.1.2		Monthly Progress Reports (Monthly)		1139	03/01/99 A	10/31/05						

WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
1.2.1.3	Phase A Concept Study Report	0	10/29/99 A							
1.2.1.4	Financial Management Reports (Monthly)	1139	12/15/99 A	10/31/05						
1.2.1.5	Work Breakdown Structure	0	12/01/99 A							
1.2.1.6	Configuration Management Plan	0	12/16/99 A							
1.2.1.7	Project Management Plan	0	01/07/00 A							
1.2.1.8	Risk Management Plan	0	01/17/00 A							
1.2.1.9	Product Assurance Plan	0	01/31/00 A							
1.2.1.10	Verification Plan	0	04/21/00 A							
1.2.1.11	EIS Component Specification	0	04/21/00 A							
1.2.1.12	Preliminary Design Review Data Package	0	04/21/00 A							
1.2.1.13	Interface Control Documents	0	04/21/00 A							
1.2.1.14	Contamination Control Plan - Updated	0	02/27/01 A							
1.2.1.15	System Error Budget	0	04/21/00 A							
1.2.1.16	Critical Design Review Data Package	0	06/20/01 A							
1.2.1.17	Security Plans for Major Applications	0	03/02/01 A							
1.2.1.18	ECP's and Associated Documentation	0	06/20/01 A							
1.2.1.19	Deviation/Waiver Approval Request (A/R)	0	06/21/01							
1.2.1.20	Engineering Drawings and Associated Lists	0	06/21/01							
1.2.1.21	Handling and Transportation Plan	0	06/20/01 A							
1.2.1.22	Data Management Plan	0	06/20/01 A							
1.2.1.23	Acceptance Data Package	0	01/29/02							
1.2.1.24	Verification Test Reports	0	08/15/02							
1.3	Procurement Management	74 *	06/01/99 A	10/01/01						
1.3.1	Planning	0	06/01/99 A	05/01/00 A						
1.3.2	Procurement	74	02/11/00 A	10/01/01						
1.4	Configuration Management	314 *	02/01/99 A	09/02/02						
1.4.1	Definition and Planning	0	02/01/99 A	03/15/00 A						
1.4.2	Implementation	15	03/15/00 A	07/10/01						
1.4.3	Configuration Control	314	06/01/00 A	09/02/02						
1.5	Science Support	1139 *	02/01/99 A	10/31/05						
1.5.1	Science Definition	15	02/01/99 A	07/10/01						
1.5.2	Science Support	1124	07/11/01	10/31/05						
1.5.3	Education & Public Outreach	1139	10/01/99 A	10/31/05						
2.0	Flight System	218 *	02/01/99 A	04/19/02						
2.1	Front Filter Assembly	164 *	06/01/99 A	02/04/02						
2.1.1	Development Model (DM) Filter Assembly	8 *	06/01/99 A	06/29/01						
2.1.1.1	Specify filter requirements	0	06/01/99 A	08/02/99 A						
2.1.1.2	Design Filter Frame	0	08/03/99 A	07/03/00 A						
2.1.1.4	Procure DM Filter Frames	0	09/15/00 A	01/12/01 A						
2.1.1.5	Fit Check DM Filter Frames	0	01/15/01 A	01/26/01 A						
2.1.1.6	Procure Commercial Equivalent Filter	0	11/27/00 A	03/23/01 A						
2.1.1.7	Integrate DM Filter Assembly	0	03/26/01 A	06/01/01 A						
2.1.1.8	Fabricate Mock-up Clamshell Assembly (UB)	0	01/08/01 A	05/11/01 A						
2.1.1.9	Vacuum Test EM Clamshell	0	06/04/01 A	06/15/01 A						

WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.1.1.10	Integrate FFA Assembly for Test	1	06/20/01	06/20/01						
2.1.1.11	Fabricate vibration test fixture	0	04/23/01 A	04/27/01 A						
2.1.1.12	Visual Inspection	1	06/21/01	06/21/01						
2.1.1.13	DM Acoustic/Vibration Test	5	06/22/01	06/28/01						
2.1.1.14	Visual Inspection	1	06/29/01	06/29/01						
2.1.2	Flight Model (FM) Filter	150 *	07/10/01	02/04/02						
2.1.2.1	Update Filter Design	10	07/10/01	07/23/01						
2.1.2.2	Procure Flight Filter(s)	60	07/24/01	10/15/01						
2.1.2.3	Assemble Flight Filter Assembly	20	10/16/01	11/12/01						
2.1.2.4	Integrate to Clamshell Housing	20	11/13/01	12/10/01						
2.1.2.5	Test and Debug	40	12/11/01	02/04/02						
2.2	Mirror Assembly	173 *	02/01/99 A	02/15/02						
2.2.1	Development Model (DM) Mirror Assembly	37 *	06/01/99 A	08/09/01						
2.2.1.1	Define Mirror optical requirements	0	06/01/99 A	11/01/99 A						
2.2.1.2	Preliminary design fine scan mechanism	0	06/01/99 A	11/01/99 A						
2.2.1.3	Fabricate fine scan mechanism	0	11/02/99 A	12/13/99 A						
2.2.1.4	Test/debug fine scan mechanism	0	12/13/99 A	01/07/00 A						
2.2.1.5	Preliminary design coarse scan mechanism	0	12/15/99 A	02/15/00 A						
2.2.1.6	Fabricate coarse scan subassembly	0	02/16/00 A	03/07/00 A						
2.2.1.7	Procure commercial mechanism stepper motor/resol	0	04/10/00 A	08/11/00 A						
2.2.1.8	Assembly scanning mechanism	0	08/14/00 A	01/05/01 A						
2.2.1.9	Conduct static load testing	0	01/08/01 A	01/19/01 A						
2.2.1.10	Develop bonding technique procedures	0	12/06/99 A	12/17/99 A						
2.2.1.11	Perform bonding test case using mass sim glass	0	12/17/99 A	12/23/99 A						
2.2.1.12	Perform pull/strength test on bond case	0	12/24/99 A	12/30/99 A						
2.2.1.13	Evaluate lightweighting MIR optics	0	12/18/00 A	04/13/01 A						
2.2.1.14	Black Anodize Machine Parts	0	04/02/01 A	04/13/01 A						
2.2.1.15	Integrate mirror assembly	0	04/16/01 A	04/20/01 A						
2.2.1.16	Test and Debug/Functional Tests	0	06/11/01 A	06/15/01 A						
2.2.1.17	Fabricate vibration test fixture	0	04/23/01 A	04/27/01 A						
2.2.1.18	Vibration Test	0	06/18/01 A	06/20/01 A						
2.2.1.19	Functional Test	2	06/20/01	06/21/01						
2.2.1.20	Thermal Vacuum Test	10	06/22/01	07/05/01						
2.2.1.21	Functional Test	2	07/06/01	07/09/01						
2.2.1.22	Life Test	20	07/10/01	08/06/01						
2.2.1.23	Functional Test	3	08/07/01	08/09/01						
2.2.2	Flight Model (FM) Mirror	173 *	04/02/01 A	02/15/02						
2.2.2.1	Update optical design	10	08/10/01	08/23/01						
2.2.2.2	Update scanning mechanism design	20	07/10/01	08/06/01						
2.2.2.3	Procure Primary Mirror	65	07/09/01	10/05/01						
2.2.2.4	Coat primary mirror	20	10/08/01	11/02/01						
2.2.2.5	Characterize primary mirror	20	11/05/01	11/30/01						
2.2.2.6	Procure flight stepper motor/resolver	73	04/02/01 A	09/28/01						
2.2.2.7	Fabricate and assemble scanning mechanism	60	08/07/01	10/29/01						

WBS Code		Description		Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.4.1.4		Evaluate Filter Design		20	07/05/01	08/01/01						
2.4.1.5		Visual Inspection		2	08/02/01	08/03/01						
2.4.1.6		Acoustic		3	08/06/01	08/08/01						
2.4.1.7		Visual Inspection		2	08/09/01	08/10/01						
2.4.2		Flight Model Filter		135 *	08/13/01	02/15/02						
2.4.2.1		Update Filter Design		10	08/13/01	08/24/01						
2.4.2.2		Procure Flight Filter(s)		60	08/27/01	11/16/01						
2.4.2.3		Assemble Flight Filter Assembly		20	11/19/01	12/14/01						
2.4.2.4		Evaluate Filter Design		45	12/17/01	02/15/02						
2.5		Grating Assembly		168 *	02/01/99 A	02/08/02						
2.5.1		Development Model (DM) Grating Assembly		73 *	02/01/99 A	09/28/01						
2.5.1.1		Define Grating optical requirements		0	02/01/99 A	11/05/99 A						
2.5.1.2		Design focusing mechanism		0	04/26/99 A	12/31/99 A						
2.5.1.3		Fabricate focussing mechanism		0	12/31/99 A	03/23/00 A						
2.5.1.4		Procure/fabricate Mass Sim Optic		0	12/04/00 A	12/15/00 A						
2.5.1.5		Procure Commercial Stepper Motors/Resolvers		0	04/10/00 A	09/13/00 A						
2.5.1.6		Assemble focusing mechanism		0	06/16/00 A	10/06/00 A						
2.5.1.7		Integrate mass sim		0	01/03/01 A	01/19/01 A						
2.5.1.8		Test and debug		0	01/22/01 A	02/09/01 A						
2.5.1.9		Static load testing		0	02/12/01 A	02/16/01 A						
2.5.1.10		Functional testing		21	02/26/01 A	07/18/01						
2.5.1.11		Fabricate test fixture		0	04/23/01 A	04/27/01 A						
2.5.1.12		Vibration		3	07/19/01	07/23/01						
2.5.1.13		Functional Test		3	07/24/01	07/26/01						
2.5.1.14		Thermal Vacuum		20	07/27/01	08/23/01						
2.5.1.15		Functional Test		3	08/24/01	08/28/01						
2.5.1.16		Life Test		20	08/29/01	09/25/01						
2.5.1.17		Functional Test		3	09/26/01	09/28/01						
2.5.2		Flight Model Grating		168 *	03/24/00 A	02/08/02						
2.5.2.1		Update optical design		10	10/01/01	10/12/01						
2.5.2.2		Update focusing mechanism design		10	07/24/01	08/06/01						
2.5.2.3		Procure flight grating		73	03/24/00 A	09/28/01						
2.5.2.4		Coat flight grating		20	10/01/01	10/26/01						
2.5.2.5		Characterize flight grating		20	10/29/01	11/23/01						
2.5.2.6		Procure set-up gratings		16	05/19/00 A	07/11/01						
2.5.2.7		Coat set-up gratings		30	07/12/01	08/22/01						
2.5.2.8		Characterize set-up gratings		30	08/23/01	10/03/01						
2.5.2.9		Procure/fabricate focusing mechanism		40	08/07/01	10/01/01						
2.5.2.10		Procure flight stepper motor/resolver		73	04/02/01 A	09/28/01						
2.5.2.11		Assemble focusing mechanism		40	10/01/01	11/23/01						
2.5.2.12		Integrate focusing mechanism - grating optics		15	11/26/01	12/14/01						
2.5.2.13		Spectrometer optical functional testing		40	12/17/01	02/08/02						
2.6		Mechanism Driver Electronics		218 *	05/31/01 A	04/19/02						
2.6.1		Hardware: Analog, Digital and Auxiliary CCA's		218 *	05/31/01 A	04/19/02						

WBS Code		Description		Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
2.6.1.1	Brassboard Development	95 *	05/31/01 A	10/30/01								
2.6.1.1.1	Integration of BB CCAs to Power Converter Subsy	0	06/04/01 A	06/08/01 A								
2.6.1.1.2	Test and Debug	10	05/31/01 A	07/03/01								
2.6.1.1.3	Develop Draft EEE Parts List	0	05/31/01 A	06/20/01 A								
2.6.1.1.4	Layout/fabricate Brassboard PWB's	20	07/04/01	07/31/01								
2.6.1.1.5	Procure/receive brassboard components	40	06/20/01	08/14/01								
2.6.1.1.6	Assemble brassboard CCAs	10	08/15/01	08/28/01								
2.6.1.1.7	Test and debug CCA's	20	08/29/01	09/25/01								
2.6.1.1.8	Integrate embedded code, test and debug	25	08/29/01	10/02/01								
2.6.1.1.9	Integrate and test with DM Pwr Coverter Subsys	10	10/03/01	10/16/01								
2.6.1.1.10	Test and debug with DM mechanisms	10	10/17/01	10/30/01								
2.6.1.1.11	Deliver to MSSL for ICU integration and test	0		10/30/01								
2.6.1.2	Flight Development	218 *	05/31/01 A	04/19/02								
2.6.1.2.1	Flight parts list development	15	05/31/01 A	07/10/01								
2.6.1.2.2	Procurement plan development	15	06/11/01 A	07/10/01								
2.6.1.2.3	Flight parts procurement	20	06/25/01	07/20/01								
2.6.1.2.4	Flight parts receipt	90	07/16/01	11/16/01								
2.6.1.2.5	EEE parts screening	45	10/01/01	11/30/01								
2.6.1.2.6	Release flight PWB's	0	10/31/01									
2.6.1.2.7	Procure PWB's	10	10/31/01	11/13/01								
2.6.1.2.8	Receive and inspect PWB's	5	11/14/01	11/20/01								
2.6.1.2.9	Coupon testing	15	11/14/01	12/04/01								
2.6.1.2.10	Release flight CCA drawing	0	10/31/01									
2.6.1.2.11	Generate CCA assembly drawings	10	10/31/01	11/13/01								
2.6.1.2.12	Kit CCA's	10	12/03/01	12/14/01								
2.6.1.2.13	Kit inspections	5	12/17/01	12/21/01								
2.6.1.2.14	Assemble CCA's	20	12/24/01	01/18/02								
2.6.1.2.15	Trim test	20	01/21/02	02/15/02								
2.6.1.2.16	Rework (A/R) and inspection	5	02/18/02	02/22/02								
2.6.1.2.17	Integrate flight embedded code	5	02/25/02	03/01/02								
2.6.1.2.18	Functional test	15	03/04/02	03/22/02								
2.6.1.2.19	Integrate housing and power subsystem	5	03/25/02	03/29/02								
2.6.1.2.20	Functional test	15	04/01/02	04/19/02								
2.6.2	Embedded Control Code	203 *	06/11/01 A	03/29/02								
2.6.2.1	Develop and deliver MDC simulator to MSSL	10	07/18/01	07/31/01								
2.6.2.1	Validate commanding/telemetry with ICU (MSSL)	10	08/01/01	08/14/01								
2.6.2.1	Update embedded code	50	06/11/01 A	08/28/01								
2.6.2.1	Integrate into brassboard hardware	0	08/29/01									
2.6.2.1	Test, Debug and Validate	128	08/29/01	02/22/02								
2.6.2.1	Integrate with Flight CCA's	0	02/25/02									
2.6.2.1	Test, Debug and Validate	25	02/25/02	03/29/02								
3	Ground Support Equipment and Proto Models	105 *	09/01/99 A	11/13/01								
3.1	Electrical Proto Model	20 *	11/01/99 A	07/17/01								
3.1.1	Mechanism Driver Electronics Proto Design	0	11/01/99 A	12/31/99 A								

WBS Code		Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
3.1.2		Procure Components	0	12/31/99 A	02/10/00 A						
3.1.3		Fabricate PCB's	0	04/10/00 A	05/05/00 A						
3.1.4		Assembly Proto Model	0	02/11/00 A	03/09/00 A						
3.1.5		Test and Debug	20	05/26/00 A	07/17/01						
3.1.6		Develop CDR Data Package for MHC	15	05/21/01 A	07/10/01						
3.2		Mechanical/Thermal Prot Model	0 *	12/08/00 A	02/21/01 A						
3.2.1		Fabricate Grating Mass model	0	12/08/00 A	02/16/01 A						
3.2.2		Deliver to MSSL	0	02/21/01 A							
3.2.3		Fabricate Mirror mass model	0	12/08/00 A	02/16/01 A						
3.2.4		Deliver to MSSL	0	02/21/01 A							
3.2.5		Fabricate Slit/Slot/Shutter mass model	0	12/08/00 A	02/16/01 A						
3.2.6		Deliver to MSSL	0	02/21/01 A							
3.3		Electrical Ground Support Equipment	70 *	02/01/00 A	10/23/01						
3.3.1		Complete Mechanism Controller	0	07/18/01							
3.3.3		Procure Assemblies (AVR)	10	07/18/01	07/31/01						
3.3.2		Define EGSE Requirements	0	02/01/00 A	02/01/00 A						
3.3.4		Assemble EGSE	40	08/01/01	09/25/01						
3.3.5		Test and Debug	20	09/26/01	10/23/01						
3.4		Mechanical Ground Support Equipment	105 *	02/01/00 A	11/13/01						
3.4.1		Define MGSE Requirements	0	02/01/00 A	04/24/00 A						
3.4.2		Fabricate MGSE	45	03/19/01 A	08/21/01						
3.4.3		Test MGSE	60	08/22/01	11/13/01						
3.5		Mock-ups and Simulators	0 *	09/01/99 A	01/12/01 A						
3.5.1		Front Filter Assembly	0 *	09/01/99 A	01/12/01 A						
3.5.1.1		Support UB in design of FFA Clamshell	0	03/28/00 A	01/12/01 A						
3.5.1.2		Support UB in fabrication of Clamshell	0	03/28/00 A	01/12/01 A						
4		Systems Engineering and Integration	1118 *	02/02/99 A	09/30/05						
4.1		Systems Engineering	1118 *	02/02/99 A	09/30/05						
4.1.1		Systems Engineering Support	1118	02/02/99 A	09/30/05						
4.1.2		MSSL systems engineering support	642	06/01/99 A	12/04/03						
4.1.3		U. of B. systems engineering support	642	06/02/99 A	12/04/03						
4.2		Instrument Components Testing and Verification	141 *	02/18/02	09/02/02						
4.2.1		Environmental Acceptance Testing	138 *	02/18/02	08/28/02						
4.2.1.1		Flight system development contingency	13	02/18/02	03/06/02						
4.2.1.2		Assembly functional tests	10	03/07/02	03/20/02						
4.2.1.3		Acoustic testing (as applicable)	10	03/21/02	04/03/02						
4.2.1.4		Assembly functional test	10	04/04/02	04/17/02						
4.2.1.5		Acceptance level vibration	5	04/22/02	04/26/02						
4.2.1.6		Assembly functional test	10	04/29/02	05/10/02						
4.2.1.7		Thermal vacuum	25	05/13/02	06/14/02						
4.2.1.8		Assembly functional test	10	06/17/02	06/28/02						
4.2.1.9		Final optical throughput verification	20	07/01/02	07/26/02						
4.2.1.10		Final inspection	3	07/29/02	07/31/02						
4.2.1.11		Testing contingency	20	08/01/02	08/28/02						

WBS Code	Description	Rem Dur	Early Start	Early Finish	2000	2001	2002	2003	2004	2005
4.2.2	Assembly Shipment	3 *	08/29/02	09/02/02						
4.2.2.1	Preparation for shipment	3	08/29/02	09/02/02						
4.2.2.2	Shipment to UK	0		09/02/02 *						
4.3	EIS System Integration and Test Support	315 *	09/17/02	12/02/03						
4.3.1	EIS Instrument Components Receipt at RAL	0	09/17/02							
4.3.2	EIS system integration	55	09/17/02	12/02/02						
4.3.3	EIS instrument test	90	12/03/02	04/07/03						
4.3.4	EIS instrument calibration	90	04/08/03	08/11/03						
4.3.5	EIS instrument test	80	08/12/03	12/01/03						
4.3.6	EIS instrument delivery to S/C	0	12/02/03							
5	Operations	1118 *	01/01/01 A	09/30/05						
5.1	Mission Operations Definition and Planning	1118	01/01/01 A	09/30/05						
5.2	Mission Operations Support	40	08/08/05	09/30/05						
5.3	EIS Coordinated Science Assessment	1103	07/10/01	09/29/05						
6	Product Assurance	314 *	11/01/99 A	09/02/02						
6.1	Safety	314	11/01/99 A	09/02/02						
6.2	Quality	314	11/01/99 A	09/02/02						
6.3	Reliability	314	11/01/99 A	09/02/02						

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EIS CDR Baseline Program Schedule

Early bar

Progress bar

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Summary bar

Progress point

Critical point

Summary point

Start milestone point

Finish milestone point